Impact of Internal heating on the Thermal Evolution of Neutron Stars

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The impact of various competing heating processes on the thermal evolution of neutron stars is investigated. We show that internal heating yields to significantly enhanced surface temperatures for pulsars of middle aged and old age. The heating due to thermal creep of pinned vortices and to the outward motion of proton vortices in the interior of the star leads to better agreement with the observed data in the case of enhanced stellar cooling. The strong pinning models are ruled out by a comparison with the cooling data on the old pulsars. For millisecond pulsars, the heating due to thermal creep of pinned vortices and chemical heating of the core have the largest impact on the surface temperatures. The angular dependence of the heat rates require in general two dimensional cooling simulations. One such simulation is performed for a selected cases in order to check the applicability of one-dimensional cooling codes to such simulations, used in the past.

References

[1] Ch. Schaab, A. Sedrakian, F. Weber, and M. K. Weigel, Astron. Astrophys. 346 (1999) 465.